Conference: Signposts of Planets
Location: GSFC, Greenbelt, MD
Dates: October 18-20, 2011

Presentation Title:	"A Collisional Algorithm for Modeling Circumstellar Debris Disks"
Poster or Paper:	Poster
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Abstract:
Many planetary systems harbor circumstellar disks of dust and planetesimals thought to be debris left over from planet formation. These debris disks exhibit a range of morphological features which can arise from the gravitational perturbations of planets. Accurate models of these features, accounting for the interactions of the particles in a disk with each other and with whatever planets they contain, can act as signposts for planets in debris disks that otherwise could not be detected. Such models can also constrain the planet's mass and orbital parameters. Current models for many disks consider the gravitational and radiative effects of the star and planets on the disk, but neglect the morphological consequences of collisional interactions between the planetesimals. Many observed disk features are not satisfactorily explained by the current generation of models.
I am developing a new kind of debris disk model that considers both the gravitational shaping of the disk by planets and the inelastic collisions between particles. I will use a hybrid N-body integrator to numerically solve the equations of motion for the particles and planets in the disk. To include the collisional effects, I begin with an algorithm that tests for collisions at each step of the orbit integration and readjusts the velocities of colliding particles. I am adapting this algorithm to the problem at hand by allowing each particle to represent a "swarm" of planetesimals with a range of masses. When the algorithm detects an encounter between swarms, two or three swarms are produced to approximate the range of possible trajectories of the daughter planetesimals. Here I present preliminary results from my collisional algorithm.